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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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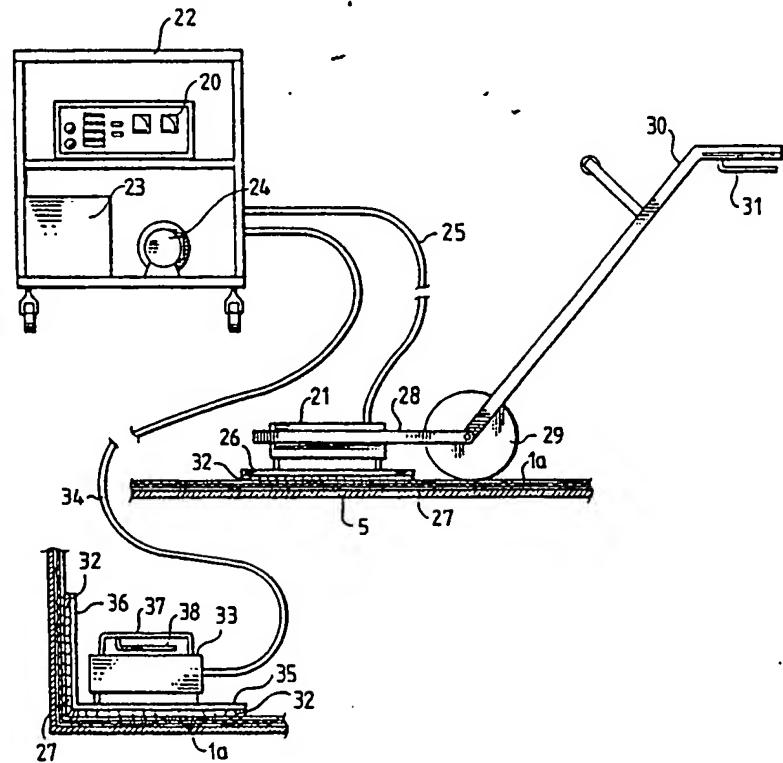
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(54) Title: METHOD OF LAYING ROOFING FELT AND MEANS THEREFOR

## (57) Abstract

A method of laying roofing felt containing bitumen which is solid at ambient temperature and softens at an increased temperature, in which method lengths (7, 8) are brought to overlap each other in overlap zones (11), and welded together by heating the bitumen to the softening temperature. According to the invention an electric current, which is generated by induction, is caused to pass through an electrically conducting heat-emitter (1) arranged within the overlap zone (11), to generate heat in the heat-emitter (1) and emit heat to opposing portions (17, 18) of the lengths (7, 8) so that the bitumen is brought to its softening temperature and the lengths (7, 8) are welded together at the opposing portions (17, 18) to form a tight, continuous overlap joint. A means for welding the lengths is also described for the purpose of which it includes one or two induction apparatus (21; 33) in addition to said heat-emitter (1).



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Method of laying roofing felt and means therefor

The present invention relates to a method of laying roofing felt on roofs, said roofing felt containing

5 bitumen which is solid at ambient temperature and softens at an increased softening temperature, in which method length of roofing felt are brought to overlap each other in overlap zones of predetermined width, and welded together by heating the bitumen to said softening

10 temperature by means of a heat-emitting member. The invention also relates to a means for use when laying roofing felt of the type described above, said means including a heat-emitting member.

15 When laying roofing felt it has been usual to spread molten tar on the surface and on the edge portion of an adjacent length and then roll out the roofing felt on the tar-coated surfaces to produce overlap joints. The tar is usually heated to liquid state in a container placed on

20 the roof, using an open flame. Due to the considerable fire risk and the fact that many extensive fires have occurred, this method entailing an open flame will in future only be permitted under personal responsibility and at great risk.

25 It is also known to heat bitumen with the aid of pre-heated air or a gas flame, the air of the gas flame being directed into the overlap zone while the edge of one length of roofing felt is left and then pressed down

30 against the other edge portion as the softening process proceeds. The use of a gas flame will shortly be prohibited for the same reason as stated above. Like the method using a gas flame, the method using pre-heated air is performed at relatively low speed and in an

35 uncomfortable working position, which may lead to uneven results.

The object of the present invention is to provide an improved method of laying roofing felt and welding together the lengths to form continuous welded seams considerably faster than said hot-air method and in a 5 more ergonomically favourable manner.

The method according to the invention is substantially characterized in that, when the overlapping lengths are in contact with each other, an electric current is caused 10 to pass through an electrically conduction heat-emitting member arranged within and extending continuously along the entire overlap zone, in that the heat-emitting member is supplied with energy by induction by means of an induction apparatus that emits a variable magnetic field 15 inducing current of suitable strength in the heat-emitting member to generate heat in the heat-emitting member, said heat being emitted to at least one of the opposing portions of the lengths within the overlap zone so that the bitumen in at least said portion is brought 20 to its softening temperature and the lengths are welded together at said opposing portions to form a tight, continuous overlap joint.

The means according to the invention is substantially 25 characterized in that the heat-emitting member is electrically conducting so that an electric current is caused to pass through it when the overlapping lengths are in contact with each other, said heat-emitting member being arranged within and extending continuously along 30 the entire overlap zone, said means also including at least one induction apparatus arranged to supply energy by means of induction to the heat-emitting member, said induction apparatus being arranged to emit a variable magnetic field inducing current of suitable strength in 35 the heat-emitting member to generate heat in the heat-emitting member, said heat being emitted to at least one of the opposing portions of the lengths within the

overlap zone so that the bitumen in at least said portion is brought to its softening temperature and the lengths are welded together at said opposing portions to form a tight, continuous overlap joint.

5

The invention will be described further in the following with reference to the drawings.

10 Figure 1 shows a length of a heat-emitting member in the form of a metal net.

Figure 2 shows a length of a heat-emitting member in the form of a perforated metal tape.

15 Figure 3 shows schematically sections of two lengths in cross section through the overlap zone.

Figure 4 shows schematically a means for welding lengths of roofing felt.

20

Figure 5 shows one of two induction apparatuses used in the means according to Figure 4 together with intermediate netting enclosed therein.

25 With reference to Figure 1, it is shown therein a length of an electrically conducting heat-emitting member 1 which, according to the invention, is supplied with energy by means of induction. In this embodiment the heat-emitting member is in the form of netting 1a of suitable metal material. The netting is of predetermined width and consists of longitudinal and transverse wires 2, 3 connected together in suitable manner. Current passes primarily through the longitudinal wires 2, while the transverse wires 3 hold the longitudinal wires 2 together and help to distribute the heat produced. The net meshes form a large number of through-openings 4 which are extremely important since the softened bitumen

can penetrate into the openings from both sides, thus producing complete adhesion of the bitumen from both lengths of roofing felt.

5 Figure 2 shows another embodiment of the heat-emitting member 1 in the form of a tape 1b of suitable metal material which is perforated so that it has a large number of through-openings 6 with the same function as the openings 4 in the netting 1a.

10

Figure 3 shows sections of two lengths 7, 8 of roofing felt in cross section, each length 7, 8 having a first edge portion 9 and a second edge portion 10 to overlap and cooperate with second and first edges portions 10, 9, 15 respectively, of two adjacent lengths (only two of the three lengths are thus shown in Figure 3). The roofing felt is provided with a carrying central layer (not shown) coated on both sides with bitumen. The upper side of the roofing felt is coated with a layer of small 20 pieces of slate, said first edge portion 9 being free from slate so that the bitumen is exposed in the same way as on the lower side of the roofing felt. The edge portion 9 has predetermined width so as to form an overlap zone 11 with the edge portion 10 of the other 25 length. Within the overlap zone 11, between the overlapping edge portions 9, 10, is a heat-emitting member in the form of the netting 1a shown in Figure 1, the width of the netting being adjusted to be slightly less than the width of the overlap zone 11. The netting 30 1a is thus entirely enclosed between the edges 12, 13 of the lengths 7, 8. The netting 1a, or other heat-emitter can be supplied separately and the desired length of netting be placed on the edge portion 9 after the length 7 of roofing felt has been laid out on the roof. However, 35 it is preferable for the netting 1a or other heat-emitter 1 to be incorporated in the roofing felt at the time of manufacture. It may thus advantageously be secured to the

slate-free bitumen surface of the edge portion 9. It may alternatively be secured to the lower side of the edge portion 10. In both cases the bitumen on the roofing felt may serve as adhesive when this has not yet solidified or

5 has been temporarily softened after solidification. Other adhesives may be used, such as a foil carrier coated with adhesive for the netting or other heat-emitter, e.g. a plurality of metal wires without transverse wires, said foil disintegrating at the softening temperature of the

10 bitumen. Alternatively the netting or other heat-emitter is placed inside the edge portion 9 or the edge portion 10 one or a few millimetres from its joint surface 14 or 15.

15 When heat is generated in the netting 1a a melt zone 16 is formed within the overlap zone, said melt zone containing opposing portions 17, 18 of both the edge portions 9, 10. When the bitumen has reached its softening temperature pressure is applied to the overlap zone, e.g. with the aid of a roller or suitable weight which is rolled over and along the overlap zone so that an upset 19 is formed, indicating that melting has occurred and thus constituting a check that a continuous, tight overlap joint has been formed.

20

25

Figure 4 shows schematically a means which can be used for laying roofing felt in the manner described above, said means comprising a heat-emitter in the form of netting 1a, a high-frequency generator 20 and a first induction apparatus 21. The generator 20 is connected to a voltage source, e.g. the existing electricity network, and is mounted on a carriage 22, the latter also carrying a water container 23 and a water pump 24. Between the carriage 22 and the induction apparatus 21 is a

30

35

connection 25 containing a high-frequency cable and also hoses for circulating water between the pump 24 and the induction apparatus 21 for continuous cooling of the

induction apparatus 21. The induction apparatus 21 has a flat inductor 26, the copper wires of which are protected by a lower glass-fibre sheet 27 which is designed to slide on the roofing felt. The glass-fibre sheet 27 may 5 be of such a thickness that the distance between the copper wires and the roofing felt is 4-5 mm. The induction apparatus 21 is carried by a tool 28 with a roller 29, journalled to allow the tool 28 and its induction apparatus to be moved manually. The tool 28 is 10 provided with a handle 30 permitting easy manoeuvring of the tool and control means 31 for control of the induction apparatus. The roller 29 is sufficiently heavy to exert pressure on the softened overlap zone. The induction apparatus 21 thus supplies energy to the 15 netting 1a by generating a variable magnetic field 32 that induces current of suitable strength in the enclosed netting for heat to be generated in the netting 1a and emitted to the bitumen in contact with the netting 1a. The means 20 is provided with suitable control equipment 20 (not shown) to enable the melting process in the melt zone 16 (Figures 3 and 5) to be controlled, the control parameters being the temperature of the roofing felt prior to heating, the quality of the roofing felt (blown or distilled bitumen which have different softening 25 temperatures) and the size of the melt zone 16.

The means according to Figure 4 also includes a second induction apparatus 33 connected to the carriage 22 by a connection 34 in the same way as the first induction 30 apparatus 21. The second induction apparatus 33 is portable and is primarily intended for use in places where the roofing felt is folded up against wall sections such as transitions or roof edges.

35 For this purpose the inductor consists of a flat horizontal part 35 and a flat vertical part 36. The induction apparatus is provided with a handle 37 and a

control device 38. Alternatively the upwardly directed inductor 36 may be adjustable so that the angle can be regulated and adjusted to the angle between the roof and said upwardly directed transition or roof edge.

5

The supply of energy to the heat-emitter 1 can be

regulated by temperature measurement. In this case one or more temperature gauges is/are placed in, beside or on top of the overlap zone and the welding process is

10 controlled on the basis of the temperature(s) registered by the gauge(s). Combining temperature measurement inside the overlap zone with temperature measurement on top of the overlap zone enables control of the extent of the melt zone 16. It is important during the welding that the

15 melt zone does not reach the upper side of the overlap joint as this would cause the slate coating to be destroyed by the bitumen exuding. It is also important that the melt zone 16 is not too small which might lead to insufficient adhesion and poor tightness.

20

The method according to the invention is also applicable when splicing the ends of two lengths of roofing felt.

The end of one length may, but need not necessarily, be provided with a part free from slate similar to the edge portion 9 in Figure 3.

25 The technique using a heat-emitter according to the invention can also be utilized to secure roofing felt to the actual base surface 5 of the roof. In this case a suitable length of heat-emitter is placed on the base surface and then covered with a length of roofing felt so that the heat-emitter is located substantially in the middle of the length in its longitudinally direction.

30 Alternatively several heat-emitters may be arranged beside each other. When a current is conducted through the heat-emitter it emits heat to the bitumen so that this softens and comes into adhesive contact with the

surface below. When the bitumen solidifies it will form a firm joint between roofing felt and roof. Alternatively the heat-emitter may be joined to the roofing felt from the start, e.g. secured to the lower side of the roofing 5 felt or enclosed in the roofing felt one or a few millimetres from the lower side.

It will be understood that the heat-emitter becomes a part of the joint formed since the heat-emitter is 10 enclosed in the solidified bitumen.

## C L A I M S

1. A method of laying roofing felt on roofs, said roofing felt containing bitumen which is solid at ambient temperature and softens at an increased softening temperature, in which method lengths (7, 8) of roofing felt are brought to overlap each other in overlap zones (11) of predetermined width, and welded together by heating the bitumen to said softening temperature by means of a heat-emitting member, characterized in that, when the overlapping lengths (7, 8) are in contact with each other, an electric current is caused to pass through an electrically conducting heat-emitting member (1) arranged within and extending continuously along the entire overlap zone (11), in that the heat-emitting member (1) is supplied with energy by induction by means of an induction apparatus (21; 33) that emits a variable magnetic field (32) inducing current of suitable strength in the heat-emitting member (1) to generate heat in the heat-emitting member (1), said heat being emitted to at least one of the opposing portions (17, 18) of the lengths (7, 8) within the overlap zone (11) so that the bitumen in at least said portion (17 and/or 18) is brought to its softening temperature and the lengths (7, 8) are welded together at said opposing portions (17, 18) to form a tight continuous overlap joint.
2. A method as claimed in claim 1, characterized in that the softening process is controlled by control equipment that takes into account various control parameters such as the temperature of the roofing felt prior to heating, the quality of the roofing felt and the size of the melt zone (16).
3. A method as claimed in either of claims 1 or 2, characterized in that the heat-emitting member (1)

comprises a net (1a) or tape (1b) of metal with openings (4; 6) for penetration of softened bitumen.

4. A method as claimed in any of claims 1-3,  
5 characterized in that the heat-emitting member (1) is  
adapted to the overlap zone (11) so that its width is  
somewhat less than the width of the overlap zone (16).
- 10 5. A method as claimed in claim 1, characterized in  
that a length of roofing felt (7, 8) is secured to the  
base surface (5) by an electric current also being caused  
to pass through at least one electrically conducting  
heat-emitting member (1) located between the length  
(7, 8) and the base surface (5), in order to generate  
15 heat in the heat-emitting member and emit heat to the  
length of roofing felt so that the bitumen is brought to  
its softening temperature and the length is welded to the  
surface in order to form a firm joint.
- 20 6. A means for use in laying roofing felt on roofs,  
said roofing felt containing bitumen which is solid at  
ambient temperature and softens at an increased softening  
temperature, said means comprising a heat-emitting  
member, lengths (7, 8) of roofing felt being brought to  
25 overlap each other in overlap zones (11) of predetermined  
width, and being welded together by heating the bitumen  
to said softening temperature by means of said heat-  
emitting member, characterized in that the heat-emitting  
member is electrically conducting so that an electric  
30 current is caused to pass through it when the overlapping  
lengths (7, 8) are in contact with each other, said heat-  
emitting member (1) being arranged within and extending  
continuously along the entire overlap zone (11), said  
means also including at least one induction apparatus  
35 (21; 33) arranged to supply energy by means of induction  
to the heat-emitting member (1), said induction apparatus

(21; 33) being arranged to emit a variable magnetic field (32) inducing current of suitable strength in the heat-emitting member (1) to generate heat in the heat-emitting member (1), said heat being emitted to at least 5 one of the opposing portions (17, 18) of the lengths (7, 8) within the overlap zone (11) so that the bitumen in at least said portion (17 and/or 18) is brought to its softening temperature and the lengths (7, 8) are welded together at said opposing portions (17, 18) to form a 10 tight, continuous overlap joint.

7. A means as claimed in claim 6, characterized in that it includes control equipment arranged to control the softening process and to take into account various 15 control parameters such as the temperature of the roofing felt prior to heating, the quality of the roofing felt and the size of the melt zone (16).

8. A means as claimed in claim 6 or 7, characterized in 20 that the induction apparatus (21; 33) is connected to a high-frequency generator (20) and a source of coolant for cooling the induction apparatus, said coolant being preferably circulated.

25 9. A means as claimed in any of claims 6-8, characterized in that it includes a first induction apparatus carried on a roller and having a horizontal, flat inductor (26), and a second, manually operated induction apparatus (33) having a horizontal, flat 30 inductor (35) and a flat inductor (36) forming a fixed or adjustable angle to the first inductor (35) corresponding to the angle between a roof and an upwardly directed transition or roof edge.

10. A means as claimed in any of claims 6-9,  
characterized in that the heat-emitting member (1)  
comprises a net (1a) or tape (1b) of metal with openings  
5 (4; 6) for penetration of softened bitumen.

1/2

Fig. 1

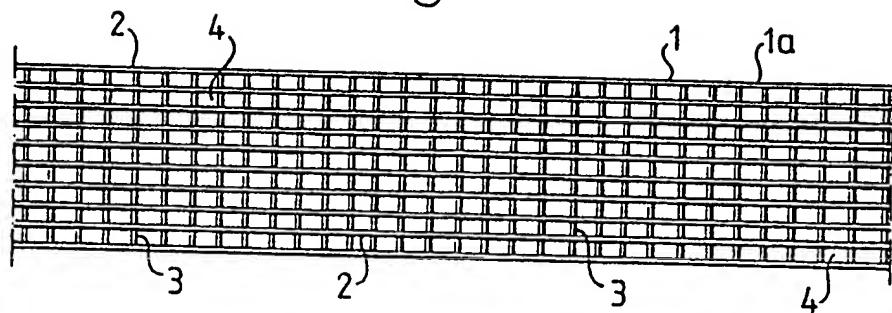


Fig. 2

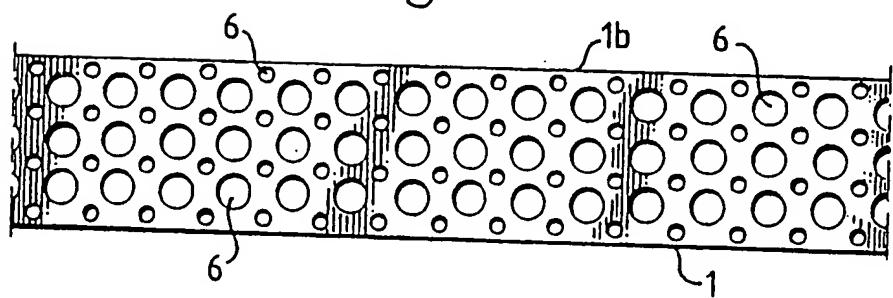
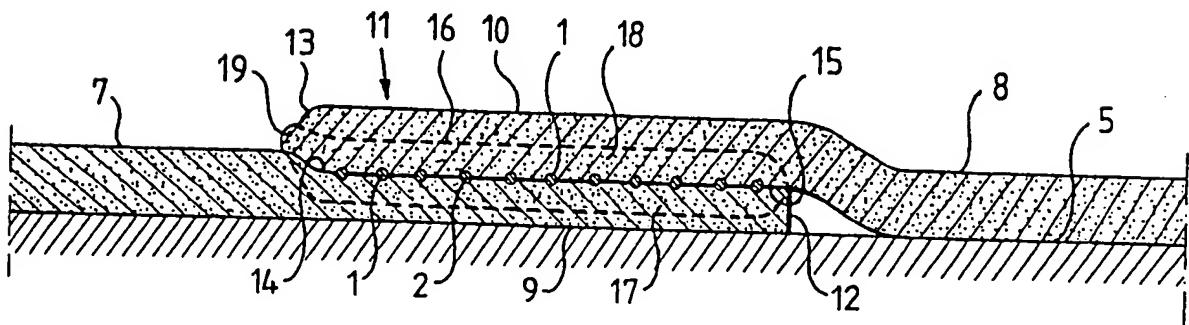


Fig. 3



ANNEX TO THE INTERNATIONAL SEARCH REPORT  
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